

REMARKS

Reconsideration of the December 4, 2002 Official Action is respectfully requested.

Claims 1-23 are pending in the application for the Examiner's review and consideration.

Claim 1 was rejected under 35 U.S.C. § 112, first paragraph, as allegedly containing subject matter that was not described in the specification. The reasons for the rejection are given in paragraph 5 on page 2 of the Official Action. The Official Action alleges that there is no support in the specification for a dielectric layer underlying the substrate. To remove any ambiguity as to the location of the underlying dielectric layer, Claim 1 has been amended to clarify that the layer of silicon nitride has an underlying and/or overlying dielectric layer. Also, Claim 1 has been amended to recite an etch rate selectivity of at least about 10. Support for this change can be found at page 14, line 16 of the specification. Because the amendment to Claim 1 does not raise any new issues and simplifies issues for appeal by overcoming the rejection under 35 U.S.C. § 112, first paragraph, entry thereof is respectfully requested pursuant to 37 C.F.R. § 1.116.

Claims 1-23 were rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over U.S. Patent No. 6,380,096 to Hung ("Hung") in view of U.S. Patent No. 6,362,109 to Kim et al. ("Kim"). The reasons for the rejection are set forth in numbered paragraph 7 on pages 3-6 of the Official Action. The Official Action alleges that it would have been obvious to etch the silicon oxide and silicon nitride layers in the medium density reactor of Kim using the plasma etching process of Hung. This rejection is respectfully traversed.

Reconsideration of the rejection is requested in view of the following legal precedent regarding rejections based on a combination of prior art references. If the proposed

modification or combination of the prior art would change the principle of operation of the prior invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959). Furthermore, a prior art reference must be considered in its entirety, *i.e.*, as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

Claim 1 recites a process for *etching a silicon nitride layer with selectivity to an underlying and/or overlying dielectric layer*, comprising (i) introducing a semiconductor substrate into a *medium density* plasma etching reactor, the semiconductor substrate having a layer of silicon nitride and the layer of silicon nitride having an underlying and/or overlying dielectric layer; (ii) supplying etching gas to the plasma etching reactor and energizing the etching gas into a plasma state, the etching gas including at least one fluorocarbon reactant and at least one oxygen reactant supplied to the plasma etching reactor at a flow rate ratio of oxygen reactant to fluorocarbon reactant of 1.5 or less; (iii) etching exposed portions of the silicon nitride layer with the plasma so as to etch openings in the silicon nitride layer with the plasma while providing an etch rate selectivity of the etching rate of the silicon nitride layer to the etching rate of the dielectric layer of at least about 10. The combination of features recited in Claim 1 is not suggested by the combination of Hung and Kim.

In contrast to the claimed process, Hung discloses a process carried out in a *high density* plasma reactor (See abstract). According to Hung, a high density reactor provides

both the selectivity and the process flexibility required to satisfy the conflicting requirements of a multi-step process (See column 3, lines 23-41). The process recited in Claim 1 is carried out in a medium density reactor. As explained in the specification, medium density plasma reactors are operated at pressures above 30 mTorr, preferably above 80 mTorr, whereas high density plasma reactors are operated at pressures below 30 mTorr, preferably below 10 mTorr (See specification at page 12, lines 5-11). Further, the species produced in a medium density reactor differ substantially from the species produced in a high density reactor.

Kim was cited for disclosing a medium density plasma reactor. Kim discloses a single step plasma etching process *for etching both oxide and nitride* with selectivity to photoresist and silicon (See abstract). In contrast, Claim 1 is directed to a process of etching silicon nitride with an etch rate selectivity of silicon nitride to dielectric of at least 10. Kims seeks a contrary result, *i.e.*, to "*reduce the selectivity to nitride*, permitting a one-step oxide/nitride etch" (See column 4, lines 52-53). In fact, Kim reports an etch rate selectivity of 1.5 and thus *teaches away* from a selectivity of more than 10 (See column 5, lines 22-26). Accordingly, any combination of Kim and Hung would lead away from the combination of features recited in Claim 1.

In a process of Kim, a fluorocarbon gas and an oxygen-containing gas are used to etch oxide and nitride where "the nitride is etched through somewhat *slower* than the oxide" (See Table I and column 5, lines 20-26). Furthermore, Kim discloses that the combination of CH₂F₂ (a hydrofluorocarbon) and CO (an oxygen-containing gas) can be used to "*reduce the selectivity to nitride*, permitting a one-step oxide/nitride etch." (See column 4, lines 43-

54). Thus, the combination of Hung and Kim would not lead to a process for *etching a silicon nitride layer* with selectivity to an underlying and/or overlying dielectric layer in a medium density plasma as required by Claim 1. The addition of Kim destroys the principle of operation of the process according to the invention of Hung. Accordingly, because Hung teaches away from using a medium density reactor and Kim seeks to etch oxide and nitride with low selectivity, Applicants submit that Claim 1 is clearly patentable over the combination of Hung and Kim.

Applicants respectfully submit at least for the reasons discussed above that Claim 1, as well as all the claims dependent therefrom, are clearly patentable over the combination of Hung and Kim.

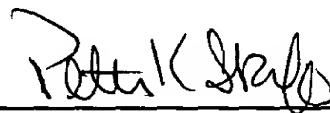
It is submitted that the differences between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been obvious at the time the invention was made to a person having ordinary skill in the art.

In view of the foregoing, it is submitted that the present application is in condition for allowance and such action is earnestly solicited.

Respectfully submitted,

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Appendix A - Attachment to Amendment

Marked-up Claim 1

1. (Amended) A process for etching a silicon nitride layer with selectivity to an underlying and/or overlying dielectric layer, comprising [the steps of]:

introducing a semiconductor substrate into a medium density plasma etching reactor, the semiconductor substrate having a layer of silicon nitride and the layer of silicon nitride having an underlying and/or overlying dielectric layer;

supplying etching gas to the plasma etching reactor and energizing the etching gas into a plasma state, the etching gas including at least one fluorocarbon reactant and at least one oxygen reactant supplied to the plasma etching reactor at a flow rate ratio of oxygen reactant to fluorocarbon reactant of 1.5 or less;

etching exposed portions of the silicon nitride layer with the plasma so as to etch openings in the silicon nitride layer with the plasma while providing an etch rate selectivity of the etching rate of the silicon nitride layer to the etching rate of the dielectric layer of at least about [5] 10.